# Micro. Notes. 02

## Loop (with Counter)

- We can loop for ~~Specific~~ Specific number of times using DJNZ instruction

DJNZ Counter, TARGET
↳ register OR Port

- This instruction will Decrement the Counter then Check if it ≠ not equal Zero then Jump to target otherwise, Continue normal Flow of execution

```
      MOV   R2, #10   } Loop for 10 times
LOOP: DJNZ  R2, LOOP  }
```

- 8051 Registers are 8-bit So we can Loop to 255 if we need more we should use nested Loop

Example: Loop for 700 times

```
      MOV   R1, #7
LOOP1: MOV  R2, #100
LOOP2: DJNZ R2, LOOP2 → inner
       DJNZ R1, LOOP1 → outer
```

## Conditional Jump

| | | Jump |
|---|---|---|
| JZ | target | → if A = 0 |
| JNZ | target | → if A ≠ 0 |
| DJNZ | R0, target | |
| CJNE | R0, #80, target | → if R0 ≠ 80 |
| JC | target | → if Carry = 1 |
| JNC | target | → if Carry = 0 |
| JB | P0.1, target | → if bit(P0.1) = 1 |
| JNB | P1.0, target | → if P1.0 ≠ 0 |
| JBC | C, target | → if C = 1 |

## JBC Instruction

- This instruction check if the bit = 1
- If that is true Jump and Clear that bit

## CJNE instruction (slide 222)

- This instruction is used to Compare two Values
- The Comparision is performed by Subtracting the two Values without Change Values in registers
- It only change the Carry

```
      CJNE  A, R0, NOT_EQUAL
      .....
NOT_EQUAL: JNC, A_G_R0   → jump not Carry
```

- If the Carry = 1 that mean [A-R0] → result is negative → A < R0
- If the Carry = 0 A ≥ R0

## Un Conditional Jump

### 1 Short Jump

SJMP target

- It take only 2 Bytes
- the first byte for opcode
- the Secon byte is a relative address (-128 → 127)

| Address | opCode | Instruction | |
|---|---|---|---|
| 0007 | XX 06 | SJMP | target |
| 0009 | XX | NOP | |
| 000F | | target: NOP | |

0F - 09 = 06

- لاحظ أنه يتم حساب الـ relative address بالإعتماد على عنوان الأمر التالي لها مباشرة إلى عنوان الذي يتم الإنتقال إليه

~~0005 - 0009~~

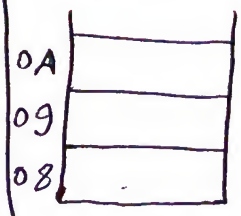
000F - 0009 = 06

- لابد أن يكون الفرق في حدود -128, 127

- جميع Conditional Jump من نوع Short Jump

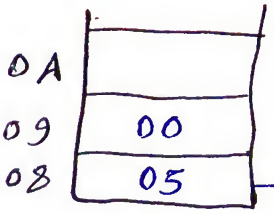
| Address | Instruction |
|---|---|
| 0002 | LCALL XYZ |
| 0005 | NOP |

Stack




SP = 07

after LCALL




SP = 09

Look At Slide 117

- pop
- push

بترتيب عكس

## 2 Long Jump

- It take 3 bytes
- The first byte for opcode
- The other two bytes is the absolute Address of the target

LJMP target

## The CALL Instructions

1. Long Call (LCALL target)
   - 3-bytes instruction
   - there are two bytes for address
2. absolute Call (ACALL target)
   - 2-bytes instruction
   - 11 bits are used for address

- The CALL instruction Store the content of Program Counter in Stack before Jump
- The RET instruction is used to pop [PC] from stack and back to instruction after Call

# Delay in 8051

- Delay depends on
  1. Crystal frequency
  2. Design of 8051

## For 8051

* Crystal freq. = 11.0592 MHz
* Clocks per Machine Cycle
  - depend on Design
  - Default = 12

## To Compute machine Cycle

$$\text{machine freq.} = \frac{\text{Crystal freq.}}{\text{Clocks per Machine cyc.}}$$

$$\text{machine cycle} = \frac{1}{\text{machine freq.}}$$

## Common no. of machine cycles for Common Instruction

| | |
|---|---|
| MOV | 1 |
| DEC | 1 |
| INC | 1 |
| DJNZ | 2 |
| LJMP | 2 |
| SJMP | 2 |
| NOP → no operation | 1 |
| MUL AB | 4 |
| PUSH | 2 |
| POP | 2 |
| RET | 2 |

Look At Examples at Slides 123 → 127

## Example

Write Delay Subroutine to introduce 100 ms delay

$$\text{Machine freq.} = \frac{11.0592}{12} = 921.6 \text{ KHz}$$

$$\text{machine cycle} = 1/921.6 \text{ KHz} = 1.085 \mu s$$

The required no. of machine cycles

$$\text{no. cycle} = \frac{100 \text{ ms}}{1.085 \mu s} = 92165.89 \simeq 92166 \text{ cycles}$$

We try to use two nested Loop

```
                          Cycle
Delay: MOV R1, ** 200 → X   1
Outer: MOV R2, ** 228 → Y   1
inner: DJNZ R2, inner       2
       DJNZ R1, outer       2
       RET                  1
```

MOV → 1
MOV → 1 * X
DJNZ → 2 * X * Y
DJNZ → 2 * X
RET → 2

$$92166 = 3 + 3X + 2XY$$

Assume $X = 150$
$Y \simeq 305 > 255$

Assume $X = 200$
$Y \simeq 229$